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灵长类化石在内蒙古二连地区上始新统的首次记录[1)]

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摘要:记录了内蒙古晚始新世的3种原始灵长类化石(*Eosimias* sp. A,*Eosimias* sp. B和*Pseudoloris erenensis* sp. nov.)。*Eosimias* sp. A系该属个体较大者,仅小于*E. paukkaungensis*。*Eosimias* sp. B个体较小,齿冠较低,主尖较细小。*Pseudoloris erenensis*的主要特征为:个体小,m2的下次小尖较靠舌侧,无颊、舌侧齿带等。*Eosimias*在内蒙古上始新统的发现,表明内蒙古在晚始新世时也是高等灵长类活动的舞台。过去已知仅分布于欧洲的*Pseudoloris*在内蒙古上始新统的发现表明,哺乳动物在晚始新世时,在亚、欧间已有某种交流。上述发现还表明,内蒙古地区晚始新世的气候可能属亚热带型,有过树木繁茂的林地。

关键词:内蒙古,晚始新世,灵长类
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古近纪的灵长类化石过去主要发现于北美和欧洲,在亚洲发现得很少(Szalay and Delson, 1979; Russell and Zhai, 1987)。近十几年来,亚洲灵长类化石发现的数量激增,特别是在中国,如山东、湖南和内蒙古的早始新世,吉林和江苏中始新世,山西、河南中－晚始新世和广西晚始新世地层中都相继发现了早期灵长类化石(王伴月、李春田,1990; Beard et al., 1994, 1996;童永生,1997;Beard, 1998;Qi and Beard, 1998;傅静芳等,2002; Beard and Wang, 1995, 2004;Ni et al., 2004, 2005, 2007; 童永生、王景文,2006)。此外,在缅甸的中始新世和巴基斯坦渐新世地层中也发现了早期灵长类化石(Jaeger et al., 1999;Marivaux et al., 2005;Takai et al., 2005)。这些发现已为国际同行所瞩目,而且研究工作也相当深入。但在我国内蒙古境内还从未有过发现晚始新世灵长类化石的报道。

20世纪80－90年代,中国科学院古脊椎动物与古人类研究所与内蒙古二连恐龙博物馆联合组队在内蒙古考察时,在二连地区晚始新世地层中采集到一些灵长类化石。尽管材料十分稀少,但这是灵长类化石在内蒙古上始新统中的首次发现。这一发现扩大了灵长类的分布范围,丰富了有关动物群的组成,并且对古动物地理和古生态环境的恢复提供了新的资料。

文中所用术语依Szalay and Delson (1979)。文中缩写:IVPP,中国科学院古脊椎动物

1)中国科学院知识创新工程重要方向项目(编号:KZCX2－YW－120)和国家自然科学基金重点项目(编号:40730210)资助。

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与古人类研究所;IVPP Loc,中国科学院古脊椎动物与古人类研究所野外地点号;IVPP V 中国科学院古脊椎动物与古人类研究所脊椎动物化石编号。

1 系统描述

灵长目 Primates Linnaeus, 1758

曙猿科 Eosimiidae Beard et al., 1994

曙猿属 *Eosimias* Beard et al., 1994

曙猿(未定种 A) *Eosimias* sp. A

(图1A)

标本 右M2一枚(IVPP V 15529)。

地点和层位 二连浩特火车站东IVPP Loc. 198801,上始新统呼尔井组。

描述和比较 M2冠面约为宽短的长方形,外缘长于内缘,具短宽的三角座。前尖和后尖为丘形,直立而不向舌侧倾斜;前尖稍大于后尖;低的前尖后棱和后尖前棱相连。前尖前棱稍短于后尖后棱。原尖稍前倾,其基部不膨大,但有明显的褶皱。原尖前、后棱钝,两棱间的夹角较锐。原尖前棱伸达前附尖,后棱伸达后尖舌侧。前附尖稍破损,但仍显得较后附尖稍高大些。无原尖后褶,也未见明显的前小尖和后小尖。齿带在舌侧很发育;前侧齿带伸达前附尖,但在近颊侧1/3处中断;后齿带伸达后附尖;颊侧齿带较舌侧的弱。舌侧齿带在原尖后内侧经磨损形成一小的磨蚀面,是否有次尖不清楚。从磨蚀面的大小和周围的情况判断,即使该处有尖存在,也不会很发育,最多只是齿带上突起的小尖。M2长:2.45 mm,宽:3.8 mm。

上述特点与曙猿科(eosimiids)动物的基本一致。特别是其三角座短宽,前尖和后尖不向舌侧倾斜,原尖前倾,原尖前、后棱钝,原尖前、后棱的夹角尖锐,齿带弱等特点均与曙猿 *Eosimias* 的相似,而与 *Bohinia* (Jaeger et al., 1999)和 *Phenacopithecus* (Beard and Wang, 2004)的明显不同;此外,在尺寸较小,原尖前、后棱的夹角较尖锐,无原小尖和后小尖等特点上也与 *Phileosimias* (Marivaux et al., 2005)的明显不同。V 15529应归入 *Eosimias* 属。*Eosimias* 属目前已知包括4种(中华曙猿 *E. sinensis*,世纪曙猿 *E. centennicus*,道森曙猿 *E. dawsonae* 和帕康曙猿 *E. paukkaungensis*)及一相似种(*E.* cf. *E. centennicus*)(Beard et al., 1994, 1996;童永生,1997;Beard and Wang, 2004; Takai et al., 2005)。*Eosimias* 属中仅 *E. centennicus* 种已知上牙。与该种的M1和M2比较,V 15529除了尺寸较大外,在原尖基部有褶皱的特点也与 *E. centennicus* 不同。此外,V 15529的尺寸显然比 *E. sinensis*、*E. centennicus* 和其相似种的大得多。至于与较大个体的 *E. dawsonae* 和 *E. paukkaungensis* 比较,因该2种仅有下颊齿,而二连浩特的标本中没有下牙,无法直接比较。幸好 *E. centennicus* 保存有上、下颊齿,可以借助 *E. centennicus* 的材料来比较。V 15529的M2比 *E. centennicus* 的M2约大1/4(前者与后者的比值:长为125.6%,宽为124.6%)。*E. dawsonae* 和 *E. paukkaungensis* 均保存有m3,*E. dawsonae* 的m3长和宽分别为 *E. centennicus* 的106.5%和107.8%,而 *E. paukkaungensis* 者为 *E. centennicus* 的133%和132%。这样,V 15529的尺寸应该介于 *E. dawsonae* 和 *E. paukkaungensis* 之间,即大于 *E. dawsonae*,

小于 *E. paukkaungensis*,但更接近于后者。V 15529 可能代表一新种,也可能是 *E. paukkaungensis* 的相似种。由于材料太少,目前暂不定种。

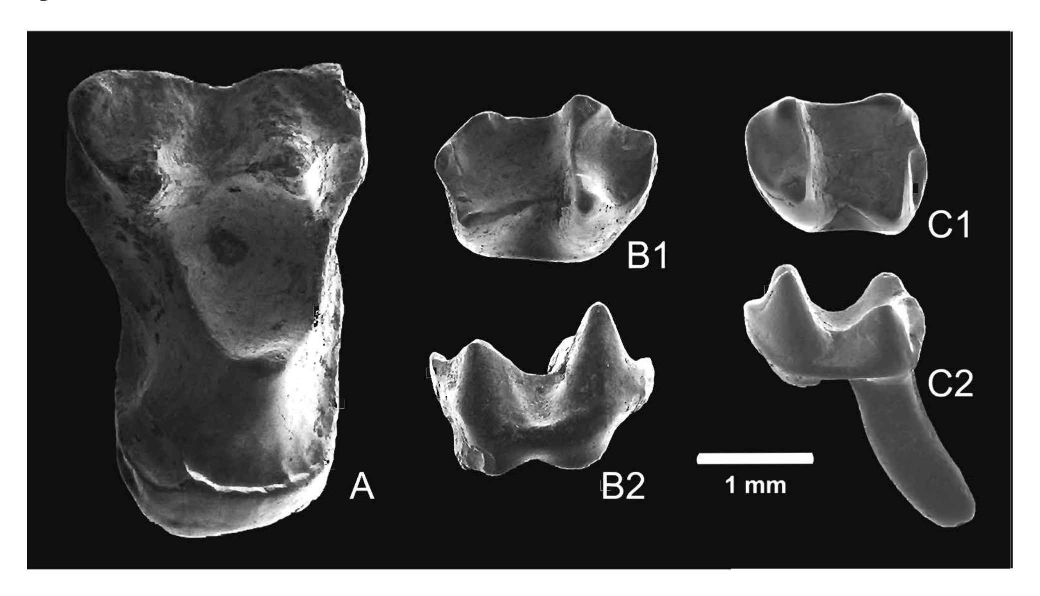


图 1　内蒙古上始新统 3 种灵长类颊齿

Fig. 1　Cheek teeth of three primates from the Upper Eocene of Nei Mongol

A. 曙猿(未定种 A) *Eosimias* sp. A, 右 right M2 (V 15529) 冠面 occlusal view; B1–B2. 曙猿(未定种 B) *Eosimias* sp. B, 右 right m1/2 (V 15530), B1. 冠面 occlusal view, B2. 颊侧面 buccal view; C1–C2. 二连假懒猴(新种) *Pseudoloris erenensis* sp. nov., 左 left m2, 正型标本 holotype (V 15531), C1. 冠面 occlusal view, C2. 颊侧面 buccal view

曙猿(未定种 B) *Eosimias* sp. B

(图 1B)

标本　右 m1/2 一枚(IVPP V 15530)。

地点和层位　乌兰察布盟四子王旗额尔登敖包 IVPP Loc. 199104;上始新统乌兰戈楚组"下白层"。

描述和比较　V 15530 为一右 m1 或 m2(简标为 m1/2)。下三角座具丘形的下前尖、下原尖和下后尖。下原尖较下后尖稍大,并与下后尖分得很开。下前尖位于齿的前舌侧,也与下后尖分得很开,但因磨蚀而显得较低。斜脊伸达下原尖后舌侧,近齿冠颊侧的 1/3 处。下内尖的位置较下次尖的稍靠前。下次小尖明显地向后突,不与下内尖靠近,更不与后者相连。齿的前、后和舌侧缘未见明显的齿带,仅在颊侧有弱的齿带。长:1.7 mm, 宽:1.2 mm。

上述特征均与 *Eosimias* 属者一致。与 *Eosimias* 属的 4 个种比较,V 15530 的尺寸显然比 *E. dawsonae* 和 *E. paukkaungensis* 的小,而与 *E. sinensis* 和 *E. centennicus* 的相近。但 V 15530 的齿冠明显较 *E. centennicus* 者低,比 *E. sinensis* 者也稍低;主尖相对较细小,下三角座盆相对较浅,下跟座稍长,下跟座盆较浅而开阔,齿带弱。与世纪曙猿(相似种)比较,

两者虽在齿冠较低、下三角座盆和下跟座盆较浅的特征上相近,但 V 15530 的主尖更细小。*Eosimias* sp. A 的 M2 和 V 15530 的 m2 无法直接比较,但根据它们与 *E. centennicus* 比较推测,V 15530 的个体要比 *Eosimias* sp. A 的小。Beard et al. (1996:84)曾指出过,*E. sinensis* 和 *E. centennicus* 在下臼齿上并无明显的区别。根据目前的材料,V 15530 究竟与其中的哪一种更接近,或甚至代表不同的属或种都难确定。目前暂时将其归入 *Eosimias* 属,不定种。

始镜猴科 Omomyidae Trouessart, 1879

假懒猴属 *Pseudoloris* Stehlin, 1916

二连假懒猴(新种)*Pseudoloris erenensis* sp. nov.

(图 1C)

正型标本 左 m2 一枚(IVPP V 15531)。

地点和层位 二连浩特火车站东 IVPP Loc. 198801,上始新统呼尔井组。

特征 个体较小的假懒猴;m2 的下次小尖位置较靠近舌侧,颊侧和舌侧均无明显的齿带。

名称来源 Erenensis = eren + ensis,Eren,二连,化石产地;ensis,拉丁文,地名形容词词尾。

描述和比较 m2 冠面约呈长方形,前缘稍窄于后缘。齿冠低,主尖尖,齿脊锐。下三角座前后明显缩短。下原尖稍大于下后尖。下后脊完全,高锐,具陡的后壁。下前脊低而短,比下后尖低很多,但无明显的下前尖。下三角座盆为前后窄的横沟形。下跟座较下三角座低而宽,下跟座盆开阔。下内尖较下次尖高。下次尖 V 形,下斜脊和后棱(postcrista)颊部均锐。下斜脊伸达下原尖之后基部。下次小尖小,但明显,靠近下内尖,距下次尖远,即位于下后边脊近舌侧约 1/3 处。齿带仅在齿的后面发育,从下次小尖向颊侧下方延伸,到下次尖之外侧即消失。m2 长 1.4 mm, 宽 1.15 mm。

由上面的描述可知,V 15531 的基本特征,如牙齿的尖和脊尖锐,下三角座前后明显缩短、下原尖稍大于下后尖、下前尖退化成较低的下前边脊、具发达的后齿带等,均与眼镜猴次目的假懒猴属(*Pseudoloris*)者一致。*Pseudoloris* 属,除存疑的 *P. reguandi* [Köhler and Moyà-Solà(1999)认为该种为无效种]外,还包括 3 个种,即 *P. parvulus*、*P. crusafonti* 和 *P. godinoti* (Stehlin, 1916; Crusafont, 1967; Louis and Sudre, 1975; Köhler and Moyà-Solà, 1999),及一未定名新种(产自德国 Weissenburg-8 的 *Pseudoloris* n. sp.; Schmidt-Kittler, 1977)。V 15531 的尺寸在 *P. parvulus* 的变异范围内(见 Godinot, 1988),而比其他 3 种都小。与 *Pseudoloris* 已知各种不同的是,V 15531 的下次小尖的位置更靠近下内尖,而且无明显的颊侧齿带。此外,V 15531 的下三角座凹向舌侧开口、无齿带封闭的特点也与 *P. godinoti* 的不同。V 15531 可能代表该属的一新种,被命名为二连假懒猴(*Pseudoloris erenensis*)。

Pseudoloris 的分布范围过去仅限于欧洲(中始新世晚期—早渐新世;Köhler and Moyà-Solà, 1999)。如果上述化石确为 *Pseudoloris*,那就表明在始新世时亚洲和欧洲动物群之间已经存在某种程度的迁徙了。

2 讨　论

2.1 灵长类的发现在古动物地理方面的意义

这次在内蒙古上始新统中虽只发现了 3 枚灵长类臼齿化石,但它们却代表了 2 属 3 种灵长类(*Eosimias* sp. A,*Eosimias* sp. B 和 *Pseudoloris erenensis*)。这至少表明在晚始新世时,内蒙古已有多种灵长类生活过。特别有意义的是,其中有 2 种是曙猿属(*Eosimias*)的。*Eosimias* 被认为是高等灵长类(类人猿亚目)原始的基干部分的代表(Beard et al., 1994)。早期高等灵长类的化石过去主要发现于非洲,因此过去一直认为非洲是高等灵长类起源的中心(Fleagle and Kay, 1987; Bonis et al., 1988; Godinot and Mahboubi, 1992)。1993 年在我国江苏溧阳中始新世的裂隙堆积中首次发现了 *Eosimias* 化石(Beard et al., 1994),随后又陆续在我国山西的中－上始新统、缅甸中始新统和巴基斯坦下渐新统中也都发现了 *Eosimias* 化石(Beard et al., 1996;Beard and Wang, 2004;童永生,1997;Takai et al., 2005)。尽管对 eosimiads 是否属类人猿亚目(Anthropoidea)存在不同的看法(Delson et al., 1999),但 *E. centennicus* 的较完好的标本,的确显示了它具有类人猿亚目的形态特征(Beard and Wang, 2004)。而 *Eosimias* 较原始的特点和出现的时代表明亚洲已是早期高等灵长类进化的舞台。但 *Eosimias* 过去仅知分布于东亚的南部、南亚和东南亚一带,最北仅达北纬 35°附近。这次在内蒙古二连地区发现的 *Eosimias* 化石,将 *Eosimias* 在始新世的分布范围向北延伸到了北纬 44°附近。这是 *Eosimias* 在始新世时在亚洲的分布的最北界。

Pseudoloris 过去仅知分布于欧洲。如果 V 15531 的确属 *Pseudoloris* 属的话,这不但是该属化石在内蒙古的首次发现,而且在亚洲也是第一次。Beard et al. (1994:609)曾经指出过,江苏溧阳的兔猴类化石与欧洲的有明显的亲缘关系。Ni et al. (2005:6)进一步指出,真灵长类在从亚洲起源后,是在早始新世时通过某种通道向欧洲和北美扩散的。上述新发现支持 Beard 等和 Ni 等提出的论断,表明从早始新世到“大间断”之前,亚、欧间确实曾存在过某种程度的哺乳动物的迁徙或交流。

2.2 晚始新世时二连地区的生态环境

内蒙古现属干旱和半干旱的温带草原区和荒漠区,雨量很少,境内物种差不多都是适应于干旱气候的物种(张荣祖,2004;杜秀荣、唐建军,2005)。那么,内蒙古在始新世时的生态环境是什么样的呢? 邱占祥、王伴月(2007)认为,内蒙古二连盆地及其附近地区在中始新世晚期至晚始新世时属亚热带气候。这一时期的气候适宜,植物茂盛,是哺乳动物在类别和数量上都十分繁盛的时期,巨犀类也得到迅速演化和发展。而巨犀类就是以乔木树冠部分的嫩枝、树叶或果实为食的,表明当时该地区可能有较茂盛的树林。现在,我们又在该地区的晚始新世地层中发现了 3 种灵长类化石。其中,*Pseudoloris* 属原猴类的眼镜猴次目。而原猴类被认为是非常好的生态指示者,它们的生活主要限于热带和亚热带森林地区(Köhler and Moyà-Solà, 1999)。眼镜猴类的现生种类也仅生活在印度尼西亚和菲律宾等亚热带地区。而 *Eosimias* 也被认为是生活在热带环境中的动物(Takai et al.,

2005)。因此,二连的灵长类化石也进一步证明了在晚始新世时二连地区的气候可能属亚热带,并有较茂盛的树林供多种灵长类栖息。这也再次证实了邱占祥、王伴月(2007)的推断。

致谢 中国科学院古脊椎动物与古人类研究所的齐陶先生和毕初珍女士,内蒙古二连恐龙博物馆的吴丽君、张全中和宁培杰等同志参加了野外考察和标本采集;本文得益于与古脊椎动物与古人类研究所的李传夔、童永生、邱铸鼎、邱占祥和倪喜军等先生的讨论;童永生和倪喜军先生还帮助提供了有关参考文献和参考对比的标本或模型;插图由张文定先生摄制,在此一并表示诚挚的谢意!

FIRST RECORD OF PRIMATE FOSSILS FROM LATE EOCENE IN EREN REGION, NEI MONGOL, CHINA

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Key words Nei Mongol, Late Eocene, Primates

Summary

During the 1980's — 1990's a few isolated teeth of fossil primates were collected from the Upper Eocene beds in Eren Region, Nei Mongol. They represent the first records of the Primates in Late Eocene of Nei Mongol. The discovery has not only expanded the distribution of the Primates in Asia, added new elements to the Late Eocene faunas of Nei Mongol, but also provided with new information on paleozoogeography and paleoenvironment of this area.

1 Systematics

Order Primates Linnaeus, 1758
Family Eosimiidae Beard et al., 1994
Genus *Eosimias* Beard et al., 1994
***Eosimias* sp. A**
(Fig. 1A)

Specimen One right M2 (IVPP V 15529).

Locality and horizon IVPP Loc. 198801, east to the Railway Station of Erenhot; Upper Eocene Houldjin Formation.

Description and comparison The M2 is tritubercular, with rather short and wide trigon. The erect and rather buccally located paracone and metacone are connected by low mesiodistally oriented postparacrista and premetacrista. The protocone is canted mesially and with well-developed obtuse pre- and postprotocristae. The angle between the pre- and postprotocristae is rather sharp. Neither postprotocone-fold (*Nannopithex*-fold) nor distinct paraconule and metaconule is present. The cingulum is nearly complete, but weaker on buccal side. M2 (L × W): 2.45 mm × 3.8 mm.

All the features mentioned above are similar to those of the eosimiids, especially to *Eosi-*

mias. *Eosimias* is known to include four species (*E. sinensis*, *E. centennicus*, *E. dawsonae* and *E. paukkaungensis*) and *E.* cf. *E. centennicus*. V 15529 is different from *E. centennicus* in being larger in size of M2 and having enamel wrinkles on the base of the protocone. Among the other species, V 15529 is larger than those of *E. sinensis* and *E. dawsonae*, but smaller than that of *E. paukkaungensis*.

Eosimias sp. B
(Fig. 1B)

Specimen　One right m1/2 (IVPP V 15530).

Locality and horizon　IVPP Loc. 199104, Urtyn Obo, Siziwang Qi; "Lower White" of Upper Eocene Ulan Gochu Formation.

Description and comparison　The m1/2 has cuspidate paraconid, protoconid and metaconid. The protoconid is widely separated from the metaconid. The paraconid is located at the mesiolingual corner and widely separated from the metaconid. The entoconid is situated more mesially than the hypoconid. The distinct hypoconulid projects distally and is separated from entoconid. m1/2 (L × W): 1.7 mm × 1.2 mm.

All the features of V 15530 are similar to those of *Eosimias*. The m1/2 (V 15530) is smaller than those of *E. dawsonae*, *E. paukkaungensis* and *Eosimias* sp. A, but closer to those of *E. sinensis* and *E. centennicus* in size. V 15530 differs from the two latters in having lower crown, smaller main cusps, shallower trigonid basin, longer talonid with shallower but broader basin. It differs from *E.* cf. *E. centennicus* in having smaller main cusps.

Family Omomyidae Trouessart, 1879
Genus *Pseudoloris* Stehlin, 1916
Pseudoloris erenensis sp. nov.
(Fig. 1C)

Holotype　One left m2 (IVPP V 15531).

Locality and horizon　IVPP Loc. 198801, east to the Railway Station of Erenhot, Upper Eocene Houldjin Formation.

Diagnosis　Small-sized *Pseudoloris*; hypoconulid located more lingually, and buccal and lingual cingula absent on m2.

Etymology　Eren, taken from Erenhot, the locality where the fossil was collected.

Description and comparison　The m2 has a low crown, a mesiodistally constricted trigonid. The main cuspids are acute and the lophids are sharp-crested and rather high. The paraconid is reduced into a low and short paralophid, which is lower than the metaconid. The posterior cingulum is well developed. All the features are similar to that of *Pseudoloris*. Among the known species of *Pseudoloris*, the size of V 15531 (L × W: 1.4 mm × 1.15 mm) is smaller than those of *P. crusafonti*, *P. godinoti* and *Pseudoloris* n. sp. from Weissenburg-8, but within the range of *P. parvulus*. V 15531 is different from the known species of *Pseudoloris* in having more lingually located hypoconulid and lacking buccal cingulum. In addition, it differs from *P. godinoti* in lacking lingual cingulum. V 15531 may represent a distinct species from known species of *Pseudoloris*, here named as *P. erenensis*.

2　Discussion

2.1　Paleozoogeographic meaning of the discovery of the primate fossils

Eosimias, as a basal anthropoid, has so far been known from the middle and south parts of East Asia (south to 35°N). The discovery of *Eosimias* from the Eren Region indicates that its

distribution area extended far northward than so far known, reaching about 44°N at least in central part of Nei Mongol in Late Eocene. *Pseudoloris* has so far been known only in Europe. The discovery of *Pseudoloris erenensis* from the Eren Region indicates that *Pseudoloris* had ever lived in Asian continent in Late Eocene as well. Beard et al. (1994:609) supposed that "Both Shanghuang adapiforms exhibit clear affinities with European taxa". Ni et al. (2005:6) pointed out that the Asian ancestor of the euprimate "may have dispersed to Euro-American". The new discovery tends to support the above notions that some kind of migration of mammals between Asia and Europe might have occurred during the period from the Early Eocene to the so-called "Grand Goupure".

2.2 Paleoenvironmental condition of Eren area in Late Eocene

Eosimias is considered to have lived in a tropical environment (Takai et al., 2005). The prosimian primates are confined mostly to tropical or subtropical forests (Köhler and Moyà-Solà, 1999). The discovery of *Eosimias* and *Pseudoloris* further proves that during the Late Eocene the climate in Eren Region might be subtropical, and the vegetation type would include woodlands with fairly dense undergrowth as suggested by Qiu and Wang (2007).

References

Beard K C, 1998. A new genus of Tarsiidae (Mammalia: Primates) from the Middle Eocene of Shanxi Province, China, with notes of the historical biogeography of tarsiers. Bull Carnegie Mus Nat Hist, **34**: 260-277

Beard K C, Qi T, Dawson M R et al., 1994. A diverse new primate fauna from Middle Eocene fissure-fillings in southeastern China. Nature, **368**: 604-609

Beard K C, Tong Y S, Dawson M R et al., 1996. Earliest complete dentition of an anthropoid primate from the late Middle Eocene of Shanxi Province, China. Science, **272**: 82-85

Beard K C, Wang J W, 1995. The first Asian plesiadapoids (Mammalia, Primatomorpha). Ann Carnegie Mus, **64**(1): 1-33

Beard K C, Wang J W, 2004. The eosimiid primates (Anthropoidea) of the Heti Formation, Yuanqu Basin, Shanxi and Henan provinces, People's Republic of China. J Hum Evol, **46**(4): 401-432

Bonis L de, Jaeger J-J, Coiffait B et al., 1988. Découverte du plus ancien primate Catarrhinien connu dans l'Éocène supérieur d'Afrique du Nord. C R Acad Sci, Ser II, **306**: 929-934

Crusafont P M, 1967. Sur queques Prosimies de l'Eocène de la zone préaxiale pyrénaïque et un essai provisoire de reclassification. No 163, Problèmes actuels de Paléontologie (Evolution des Vertébrés). Paris: Coll internat CNRS. 611-632

Delson E, Tattersall L, Van Couvering J A et al., 1999. Encyclopedia of Human Evolution and Prehistory. New York: Garland Publishing Inc. 1-753

Du X R (杜秀荣), Tang J J (唐建军), 2005. Atlas of China. Beijing: China Cartographic Publishing House. 1-326 (in Chinese)

Fleagle J G, Kay R F, 1987. The phyletic position of the Parapithecidae. J Hum Evol, **16**(6): 483-532

Fu J F (傅静芳), Wang J W (王景文), Tong Y S (童永生), 2002. The new discovery of the Plesiadapiformes from the Early Eocene of Wutu Basin, Shandong Province. Vert PalAsiat (古脊椎动物学报), **40**(3): 219-227 (in Chinese with English summary)

Godinot M, 1988. Le gisement du Bretou (Phosphorites du Quercy, Tarn-et-Garonne, France) et sa faune de vertebres de l'Eocene superieur. VI. Primates. Palaeotogr Abt A, **205**(1-6): 113-127

Godinot M, Mahboubi M, 1992. Earliest known simian primate found in Algeria. Nature, **357**: 324-326

Jaeger J-J, Thein T, Benammi M et al., 1999. A new primate from the Middle Eocene of Myanmar and the Asian early origin of anthropoids. Science, **286**: 528-530

Köhler M, Moyà-Solà S, 1999. A finding of Oligocene primates on the European continent. PNAS, **96**(25): 14664-14667

Louis P, Sudre J, 1975 Nouvelles données sur les primates de l'Eocène Supérieur européen. No 218, Problèmes actuels de

Paléontologie (Evolution des Vertébrés). Paris: Coll internat CNRS. 805–828

Marivaux L, Antoine P-O, Baqri S R H et al., 2005. Anthropoid primates from the Oligocene of Pakistan (Bugti Hills): data on early anthropoid evolution and biogeography. PNAS, **102**(24): 8436–8441

Ni X J, Beard K C, Meng J et al., 2007. Discovery of the first early Cenozoic euprimate (Mammalia) from Inner Mongolia. Am Mus Novit, (3571): 1–11

Ni X J, Hu Y M, Wang Y Q et al., 2005. A clue to the Asian origin of euprimates. Anthrop Sci, **113**: 3–9

Ni X J, Wang Y Q, Hu Y M et al., 2004. A euprimate skull from the Early Eocene of China. Nature, **427**: 65–68

Qi T, Beard K C, 1998. Late Eocene sivaladapid primate from Guangxi Zhuang Autonomous Region, People's Republic of China. J Hum Evol, **35**(3): 211–220

Qiu Z X (邱占祥), Wang B Y (王伴月), 2007. The Chinese paraceratheres. Palaeont Sin (中国古生物志), New Ser C, **29**: 1–396 (in Chinese with English summary)

Russell D E, Zhai R J, 1987. The Paleogene of Asia: mammals and stratigraphy. Mém Mus Natl Hist Nat, Sér C, Sci Terre, **52**: 1–488

Schmidt-Kittler N, 1977. Neue Primatenfunde aus unteroligozänen Karstspaltenfüllungen Süddeutschland. Mitt Bayer Staatsslg Paläont Hist Geol, **17**: 177–195

Stehlin H G, 1916. Die Säugetiere des schweizerischen Eocaens. Critischer Catalog der Materialen. Part 7, second half. Abh Schweiz Paläont Gesellsch, **41**: 1299–1552

Szalay F S, Delson E, 1979. Evolutionary History of the Primates. New York: Academic Press. 1–180

Takai M, Sein C, Tsubamoto T et al., 2005. A new eosimiid from the latest Middle Eocene in Pondaung, central Myanmar. Anthrop Sci, **113**: 17–25

Tong Y S (童永生), 1997. Middle Eocene small mammals from Liguanqiao Basin of Henan Province and Yuanqu Basin of Shanxi Province, Central China. Palaeont Sin (中国古生物志), New Ser C, **26**: 1–256 (in Chinese with English summary)

Tong Y S (童永生), Wang J W (王景文), 2006. Fossil mammals from the Early Eocene Wutu Formation of Shandong Province. Palaeont Sin (中国古生物志), New Ser C, **28**: 1–195 (in Chinese with English summary)

Wang B Y (王伴月), Li C T (李春田), 1990. First Paleogene mammalian fauna from northeast China. Vert PalAsiat (古脊椎动物学报), **28**(3): 165–205 (in Chinese with English summary)

Zhang R Z (张荣祖), 2004. Zoogeography of China. Beijing: Science Press. 1–502 (in Chinese)